
Basic Relay Terms and Definitions — Glossary

There are several sources for definitions: the C37 subcommittee on protective relays, C83 committee on Components for Electronic Equipment, and IEEE Standards Coordinating Committee on Definitions (SCC10) which as published ANSI/IEEE Std 100–1984 Dictionary of Electrical and Electronics Terms. IEC has Technical Committee 41 on all types of relays and publication 50 (446) is a chapter of definitions on electrical relays.

Addition sources: British Standard (BS) 142 Electrical Protective Relays; BS 4727 Relay and Measurement Terminology; C37–90 American National Standard for Relays and Relay System; IEC 255 International Electrotechnical Commission Standards for Electrical Relays; IEC 50 International Electrotechnical Vocabulary: Electrical Relays; IEEE Standard 37.2 Electrical Power System Device Function Numbers and other sources of terms, used in technical literature.

1. Relay Classes

Relay

An electric device that is designed to interpret input conditions in a prescribed manner and after specified conditions are met to respond to cause contact operation or similar abrupt change in an associated electric control circuit. Inputs are usually electric, but may be mechanical, thermal, or other quantities. A relay may consist of several units, when responsive to specified inputs, the combination providing the desired performance characteristic. The relays can be electrical, thermal, pneumatic, hydraulic, and other.

Electrical Relay

A device designed to produce sudden, predetermined changes in one or more electrical output circuits, when certain conditions are fulfilled in the electrical input circuits controlling the device.

Electromechanical Relay

An electrical relay in which the designed response is developed by the relative movement of mechanical elements under the action of a current in the input circuits.

Electromagnetic Relay

A relay whose operation depends upon the electromagnetic effects of current flowing in an energizing winding. There are two basic types of electromagnetic relays: attraction relay and induction relay.

Electromagnetic *attraction relay* operates by virtue of a plunger being drawn into a solenoid, or an armature being attracted to the poles of an electromagnet. Such relays may be actuated by DC or by AC quantities (current, voltage, power).

Electromagnetic *induction relay* uses the principle of the induction motor whereby torque is developed by induction in a rotor; this operating principle applies only to relays actuated by alternating current, and in dealing with those relays we shall call them simply “induction-type”

relays. Induction relays are basically induction motors. The moving element, or rotor, is usually a metal disk, although it sometimes may be a metal cylinder or cup. The stator is one or more electromagnets with current or potential coils that induce currents in the disk, causing it to rotate. The disk motion is restrained by a spring until the rotational forces are sufficient to turn the disk and bring its moving contact against the stationary contact, thus closing the circuit the relay is controlling. The greater the fault being sensed, the greater the current in the coils, and the faster the disk rotates.

Electronic Relay

Electrical relays whose functions are achieved by means of electronic components (vacuum or gas filled valves, semiconductor elements) without mechanical motion.

Hybrid Relay

A relay in which electromechanical and electronic devices are combined to perform a switching function.

Static Relay

An electrical relay in which the designed response is developed by electronic, magnetic, optical, or other components without mechanical motion.

It should be noted though that few static relays have a fully static output stage, to trip directly from thyristors, for example. By far the majority of static relays have attracted armature output elements to provide metal-to-metal contacts, which remain the preferred output medium in general.

Semiconductor Relay

Electronic relay based on semiconductor elements (transistors, thyristors, SCR, opto-couplers).

Solid-State Relay

Electronic relay, designed as single epoxy molded solid-state module (usually, opto-coupled).

2. Relay Types

AC Directional Relay

Are used most extensively to recognize the difference between current being supplied in one direction or the other in an AC circuit, and the term “directional” is derived from this usage. Basically, an AC directional relay can recognize certain differences in phase angle between two quantities, just as a DC directional relay recognizes differences in polarity. This recognition, as reflected in the contact action, is limited to differences in phase angle exceeding 90° from the phase angle at which maximum torque is developed.

AC Time Overcurrent Relay

A relay that operates when its AC input current exceeds a predetermined value, and in which the input current and operating time are inversely related through a substantial portion of the performance range.

Annunciator Relay

(target relay, signal relay, flag relay)

A non-automatically reset device that gives a number of separate visual indications upon the functioning of protective relays, indicates the present or former state of a circuit or circuits and which may also be arranged to perform a lockout function.

Auxiliary Relay

A relay that operates to assist another relay or device in the performance of a function.

Bar Relay

A relay so designed that a bar actuates several contact simultaneously.

Bimetal Relay

A form of thermal relay using a bimetallic element to activate contacts when heated electrically.

Bistable Relay

An electrical relay which, having responded to an input energizing quantity (or characteristic quantity) and having changed its condition remains in that condition after the quantity has been removed. Another appropriate further energization is required to make it change over.

Crystal Can Relay

A term used to identify a relay housed in a hermetically sealed enclosure that was originally used to enclose a frequency-control type of quartz crystal.

Current-Balance Relay

A relay that operates when the magnitude of one current exceeds the magnitude of another current by a predetermined degree.

Current-Sensing Relay

A relay that functions as a predetermined value of current; an overcurrent or an undercurrent relay, or a combination of both.

Dashpot Relay

A relay employing the dashpot principle to effect a time delay.

Dependent-Time Measuring Relay

A specified-time measuring relay for which times depend, in a specified manner, on the value of the characteristic quantity.

Differential Relay

A relay with multiple inputs that actuating when the voltage, current, or power difference between the inputs reaches a predetermined value.

Distance Relay

A relay that functions when the circuit admittance, impedance, or reactance increases or decreases beyond predetermined limits.

Dry Reed Relay

Relay with hermetically sealed, magnetically actuated reed contact. No mercury or other wetting material is used. Typical atmosphere inside the enclosure is nitrogen or a specially dried air.

Enclosed Relay

Hermetically sealed — a relay contained within an enclosure that is sealed by fusion or other comparable means to ensure a low rate of gas leakage (generally metal-to-metal or metal-to-glass sealing is employed)

Encapsulated — a relay embedded in a suitable potting compound

Sealed — a relay contained in a sealed housing

Covered — a relay contained in an unsealed housing

Dustproof — a relay with a case to protect against dust penetration

Ferreed Relay

Combined name for a special form of dry reed switch having a return magnetic paths (reeds) of high remanence material (ferrite) that provides a bistable contact.

Flasher Relay

(flashing-light relays)

A self-interrupting relay, usually by thermo-magnetic or electronic type.

Field Relay

A relay that functions on a given or abnormally low value or failure of a machine field current, or on excessive value of the reactive component of armature current in an AC machine indicating abnormally low field excitation.

Frequency Relay

A relay that functions on a predetermined value of frequency (either under or over or on normal system frequency) or rate of change of frequency.

Hermetically Sealed Relay

Relay with the highest degree of sealing (particularly relays with metal cases and glass insulators).

Impulse Relay

A relay that follows and repeats pulses, as from a telephone dial; or a relay that operates on the stored energy of a short pulses after the pulse ends; or a relay that discriminates between length and strength of pulses, operating on long or strong pulses and not operating on short or weak ones; or a relay that alternately assumes one of two positions as pulsed.

Independent-Time Measuring Relay

A specified-time measuring relay the specified time for which can be considered as being independent, within specified limits, of the value of the characteristic quantity

Integrating Relay — rare usage

A relay that operates on the energy stored from a long pulse or a series of pulses of the same or varying magnitude, for example, a thermal relay.

Instantaneous Overcurrent Relay (Rate-of-Rise Relay)

A relay that functions instantaneously on an excessive value of current or on an excessive rate of current rise, thus indicating a fault in the apparatus or circuit being protected.

Instruments Relay (Meter Relay) — rare usage

A sensitive relay in which the principle of operation is similar to that of instruments such as the electrodymanometer, iron vane, galvanometer, and moving magnet.

Interlock Relay

A relay with two or more armatures having a mechanical linkage or an electrical interconnection, or both, whereby the position of one armature permits, prevents, or causes motion of another.

Inverse-Time Relay

A relay in which the input quantity and operating time are inversely related throughout at least a substantial portion of the performance range. Types of inverse-time relays are frequently identified by such modifying adjectives as *definite minimum time*, *moderately*, *very*, and *extremely* to identify relative degree of inverseness of the operating characteristics.

Latching Relay (Lockup Relay)

A relay that maintains its contacts in the last position assumed without the need of maintaining coil energization.

Magnetic latching

A relay that remains operated, held either by remanent magnetism in the structure or by the influence of a permanent magnet, until reset.

Mechanical latching

A relay in which the armature or contacts may be latched mechanically in the operated or unoperated position until reset manually or electrically.

Lockout Relay

A variety of latching relay with manual resetting. Lockout relays are applicable where several tripping functions need to be performed by the same relay. Typical applications for these relays include: line breaker tripping and lockout, lockout of all the line breakers in the same busbar, etc. One of the most important applications of lockout relays is the combination with differential relays, where the lockout relay needs to be reset manually for avoiding accidental reclosings, when an internal fault has activated the differential relay.

Measuring Relay (Protective Relay)

- 1. A device used to detect defective or dangerous conditions and initiate suitable switching or give warning when its characteristic quantity, under specified conditions and with a specified accuracy, attains its operating value (current relay, voltage relay, power relay, etc.)
- 2. A relay designed to initiate disconnection of a part of an electrical installation or to operate a warning signal, in the case of a fault or other abnormal condition in the installation. A protective relay may include more than one unit electrical relay and accessories.

The IEEE Standard 37.2 Electrical Power System Device Function Numbers assign device numbers (1 to 100) to various types of protective relays:

Some Often Used <i>Device Function Numbers</i>			
2	Time Delay Starting Relay	52	AC Circuit Breaker
3	Checking or Interlocking Relay	53	Exciter Relay
21	Distance Relay	55	Power Factor Relay
23	Temperature Control Device	56	Field Applications Relay
25	Synchronizing Device	57	Short-Circuiting or Grounding Device
26	Apparatus Thermal Device	59	Overvoltage Relay
27	Undervoltage Relay	60	Voltage or Current Balance Relay
29	Isolating Contactor	63	Liquid or Gas Pressure Relay
30	Annunciator Relay	64	Ground Protective Relay
32	Directional Power Relay	68	Blocking Relay
36	Polarity Voltage Device	74	Alarm Relay
37	Undercurrent and Underpower Relay	76	DC Overcurrent Relay
38	Bearing Protective Device	78	Phase-Angle Measuring Relay
40	Field Relay	81	Frequency Relay
44	Unit Sequence Starting Relay	82	DC Reclosing Relay
46	Reverse Phase or Phase Balance Current Relay	85	Carrier or Pilot-Wire Receiver Relay
47	Phase-Sequence Relay	86	Lockout Relay
48	Incomplete Sequence Relay	87	Differential Relay
49	Machine or Transformer Thermal Relay	91	Voltage Directional Relay
50	Instantaneous Overcurrent or Rate-of-Rise Relay	92	Voltage and Power Directional Relay
51	AC Time Overcurrent Relay	94	Trip-Free Relay

Monostable Relay

An electrical relay, which, having responded to an input energizing quantity (or characteristic quantity) and having changed its conditions, returns to its previous.

Motor-Driven Relay

A relay whose contacts are actuated by the rotation of a motor shaft.

Neutral Relay

A relay whose operation is independent of the direction of the coil current, in contrast to a polarized relay.

Open Relay

An unenclosed relay.

Over Current Relay

Protection relay that is specifically designed to operate when its coil current reaches or exceeds a predetermined value.

Over Voltage Relay

Protection relay that is specifically designed to operate when its coil voltage reaches or exceeds a predetermined value.

Phase-Sequence Voltage Relay

A relay that functions upon a predetermined value of polyphase voltage in the desired phase sequence.

Plunger Relay

A relay operated by a movable core or plunger through solenoid action.

Polarized Relay

A relay whose operation is dependent upon the polarity of the energizing current.

Monostable (Biased) — a two-position relay that requires current of a predetermined polarity for operation and returns to the off position when the operating winding is deenergized or is energized with reversed polarity.

Bistable (Double-Biased) — a two-position relay that will remain in its last operated position keeping the operated contacts closed after the operating winding is deenergized.

Center-Stable (Un-Biased) — a polarized relay that is operated in one of two energized positions, depending on the polarity of the energizing current, and that returns to a third, off position, when the operating winding is deenergized.

Power Direction Relay

A protective relay used in protective circuits as a unit determining by the direction of power passing through the protected power line where the damage occurred: on the protected line or on some other outgoing lines adjoined to this substation.

Power Factor Relay

A relay that operates when the power factor in an AC circuit rises above or falls below a predetermined value.

Power Relay

1. A relay with heavy-duty contacts (output circuits), usually rated 10 to 25 A or higher. Sometimes called a contactor.
2. The protective relay are commonly used (as overpower relays) for protection against excess electric power flow in a predetermined direction.

Reed Relay

A relay using hermetic enclosed magnetic reeds as the contact members and coil or permanent magnet as source of operated magnetic field.

Remanent Relay (Remanence Relay)

A remanent, bistable relay adopts a particular switching position at an energizing direct current in any direction and is held in this position by the remanence in the magnetic circuit, that is, through the magnetization of parts of the magnetic circuit. The contacts shift to the other switching position on a small energizing current of limited amplitude in the opposite direction. This demagnetizes the magnetic circuit again.

RF Relay

A relay designed to switch electrical AC energy with frequencies higher than audio range (radio frequency).

Antenna Switching Relay — A special RF relay used to switch antenna circuits.

Coaxial Relay — A special RF relay that opens or closes a coaxial cable or line. It is generally a low impedance device.

Sealed Relay

Relays which are sealed against the penetration of specified PCB cleaners or lacquers.

Immersion Cleanable

Relays that can be cleaned, lacquered or cast-in together with the printed circuit board after soldering without anything penetrating the relay. The washing requires a suitable solvent. In ultrasonic washing processes, the limiting values for temperature, duration, and frequency must be observed.

Note: Relays sealed against washing can also be used for environments with aggressive atmospheres.

Starting Relay

A unit relay which responds to abnormal conditions and initiates the operation of other elements of the protective system.

Stepping Relay (Ratchet, Multiposition, Rotary)

A relay having many rotary positions, ratchet actuated, moving from one step to the next in successive operations, and usually operating its contacts by means of cams.

Telephone-Type Relay

A term sometimes applied to relay with an end on armature, an L-shaped heel piece, and contact springs mounted parallel to the long axis of the relay coil which are originally used in old telephone systems.

Thermal Relay

A relay that is actuated by the heating effects of an electrical current.

Time Delay Relay

A relay in which the actuation of the output circuit (operation or release) is delayed internally (coil slugs or sleeves), mechanically (clockwork, bellows, dashpot, etc.), or by an accompanying electronic timing circuit.

Tripping Relay (Trip-Free Relay)

A relay that functions to trip a circuit breaker, contactor or equipment, or to permit immediate tripping by other devices; or to prevent immediate reclosure of a circuit interrupter if it should open automatically even though its closing circuit is maintained closed.

Under Current Relay

A relay specifically designed to function when its energizing current falls below a predetermined value.

Under Voltage Relay

A relay specifically designed to function when its energizing voltage falls below a predetermined value.

Zero-Voltage-Turn-On (Off) Relay

A relay with isolated input and output in which added control circuitry delays the output turn-on (turn-off) until a zero voltage transition of the AC sine wave is detected. Construction may be all solid-state or hybrid with a solid-state output.

3. Parameters of Relay

Ampere-Turn

A unit of magnetizing force. The product of current flowing, measured in amperes, multiplied by the number of turns in a coil or winding.

Breakdown Voltage

Threshold value at which breakdown does not occur when AC voltage is applied between pins, similar to insulation resistance. Usually, the breakdown voltage is tested for 1 min and the current value that defines breakdown is 1 mA. The minimum value is specified.

Coil Resistance

DC resistance of the coil. Usually measured at 25°C. A tolerance of $\pm 10\%$ usually applies.

Coil Temperature Rise

Rise of the coil temperature at a given input (power or voltage).

Degree of Protection

Ratings, for example, defined in IEC 60 529, indicating how completely a cover, seal, etc., protect against water, humidity, dust, direct contact, etc.

Dielectric Strength

The maximum allowable AC rms voltage (50 or 60 Hz) which may be applied between two test points, such as the coil and case or current carrying and noncurrent carrying points, without a leakage current in excess of 1 mA.

Duty Cycle

The ratio between the switch *on* time and total cycle time during periodical switching. Fifty per cent duty cycle means the switch on time equals the switch off time.

Eddy Current (Foucault Current)

Circulating currents in magnetic field conductive materials caused by alternating magnetic fields. They represent power losses in relay core.

Electrical Life

Switching life of the contacts expressed as the number of operations measured when the rated voltage is applied to the relay and the relay is operated at the rated operating frequency with the rated load applied to the contacts.

Electromotive Force (EMF)

The force which causes current to flow in a conductor; in other words, the voltage or potential.

Flux

Magnetic lines of force.

Flux Density

Magnetic lines of force per unit of area.

Fritting

Electrical breakdown which can occur under special conditions (voltage, current) whenever thin contact films prevent electrical conductivity between closed contacts. Fritting is a process which generates (A-fritting) and/or widens (B-fritting) a conducting path through such a semi-conducting film on a contact surface. During A-fritting, electrons are injected into the undamaged film. The electron current alters the condition of the film producing a “conductive channel.” During the following B-fritting, the current widens the channel increasing the conductivity.

Inrush Current

The inrush current of a machine or apparatus is the maximum current which flows after being suddenly and fully energized.

Insulation Resistance

The minimum allowable DC resistance between two parts electrically independent of each other, case at a specified voltage, usually 500 V. Usually, this specifies the insulation resistances between the coil and contact pin, between open contact pins, and between adjacent contact pins (if the relay has two or more contacts). In addition, the insulation resistance between the pins of the contacts that are open in the operate state is also specified.

Leakage Current

Error current that can degrade sensitive measurements. Even high resistance paths between low current conductors and nearby voltage sources can generate significant leakage currents. Leakage in insulating material, micro-contamination on insulating surfaces, and moisture (humidity) can have catastrophic effects on picoamp and sub-picoamp (femtoamp) measurements.

Limiting Continuous Current (Steady State Current Limit)

The highest value of the current (effective value for alternating current) that the previously closed output circuit can permanently carry under specified conditions.

Load Life

The minimum number of cycles the relay will make, carry, and break the specified load without contact sticking or welding, and without exceeding the electrical specifications of the device.

Load life is established using various methods including Weibull probability methods.

Maximum Carry Current

Maximum current that can flow between contacts when the contacts are closed.

Maximum Coil Voltage

The maximum voltage that can be applied to the coil. Usually, the ambient temperature is specified as a condition.

Maximum Switching Current

Maximum current switchable with relay contact.

Maximum Switching Power

Maximum load power switchable with relay contact.

The value under DC load is expressed in W, and that under AC load is expressed in VA.

Maximum Voltage

The highest permissible input (coil) voltage at the reference temperature at which the relay, with continuous energization, heats up to its maximum permissible coil temperature.

Maximum Switching Voltage

Maximum voltage switchable with relay contact.

The peak value is indicated in the catalog under DC load. The effective value (rms) is indicated under AC load.

Mechanical Life

Life expressed as the number of operations that can be performed when the nominal coil voltage is applied to the relay with the contacts not loaded and the relay is operated at the rated operating frequency.

Mechanical Shock, Nonoperating

That mechanical shock level (amplitude, duration, and wave shape) to which the relay may be subjected without permanent electrical or mechanical damage (during storage or transportation).

Minimum Energization Time

The minimum impulse length at the height of the nominal voltage that is required to change the switching position of a bistable relay.

Minimum Switching Power

Minimum load power through relay contact necessary for normal operation. Expressed as the minimum values of voltage and current.

Minimum Voltage

The lowest permissible input voltage at which the relay operates reliably at the reference temperature even after continuous energization (preenergizing) and brief deenergizing.

Must Operate Voltage

Minimum voltage required to place the make contact in operate state from the release state. Normally, the contact should be driven by a rectangular waveform voltage. The maximum value is specified. In the case of a latching relay, this term means a voltage (set voltage) that is required to place the relay in the set state from the reset state.

Must Release Voltage

Maximum voltage to place the relay in the release state (the break contact is closed) from the operate state. The minimum value is specified. In the case of a latching relay, the maximum value necessary for placing the relay in the reset state from the set state, and is expressed as a reset voltage. The maximum value is specified.

Nominal Coil Voltage

A standard voltage applied to the coil to use the relay.

Operate Time

The time interval from input (coil) energization to the functioning of the last output (contact) to function. This includes time for the coil to build up its magnetic field (a significant limiting factor) and transfer time of the moveable contact between stationary contact(s), and bounce time after the initial contact make. For a solid-state or hybrid relay in a nonoperated state, the time from the application of the pickup voltage to the change of state of the output.

Operating State

Switch position of a monostable relay in the energized state. For bistable relays the switch position specified by the manufacturer.

Operating Temperature Range

The ambient temperature range over which an unmounted relay is specified to operate.

Operating Voltage Range

Permissible range of the input voltage depending on the ambient temperature.

Pickup Value

The minimum input that will cause a device to complete contact operation or similar designated action.

Pickup Voltage (or Current)

The voltage (or current) at which the device starts to operate when its operating coil is energized under conditions of normal operating temperatures.

Power Dissipation Rating of Coil

A product of the coil voltage rating and coil current. Normal power dissipation to operate the relay.

Protection Classes for Relays (according to IEC 60. 529)

Class IP 54: nonsealed relays which are protected against flux by their base plate and cover (dust-proof).

Class IP 67: describes sealed (immersion cleanable) relays.

Rated Burden

The power of burden (*watts* if DC or *volt-amperes* if AC) absorbed under the reference conditions by a given energizing circuit of a relay and determined under specified conditions.

Rated Coil Voltage

The coil voltage at which the relay is intended to operate for the prescribed duty cycle. Note: The use of any coil voltage less than rated may compromise the performance of the relay.

Rating

The nominal value of an energizing quantity, which appears in the designation of a relay.

Release

Process in which a monostable relay shifts from the operating state back to the rest state.

Release Time

The time interval from input (coil) deenergization to the functioning of the last output (contact) to function. This includes time for the coil to dropout its magnetic field (a significant limiting factor) and transfer time of the moveable contact between stationary contact(s), and bounce time after the initial contact brake. For a solid-state or hybrid relay in an operated state, the time from the application of the drop-out voltage to the change of state of the output.

Response

Process in which a relay shifts from the rest state to the operating state.

Reset

Process in which a bistable relay returns from the operating state back to the rest state.

Rest State (Release state)

Switch position of a monostable relay in the unenergized state. In bistable relays this is the switch position specified by the manufacturer.

Reset Time

The time interval that elapses from the point of time at which a bistable relay in the operating state has the nominal voltage applied in the opposite direction to the point of time at which the last output circuit has closed or opened (not including the bounce time).

Return

A relay returns when sequentially: it disengages; it passes from an operated condition towards the prescribed initial condition; and it resets.

Returning Ratio

The ratio of the returning value to the operating value.

Setting

The limiting value of a 'characteristic' or 'energizing' quantity at which the relay is designed to operate under specified conditions.

Such values are usually marked on the relay and may be expressed as direct values, percentages of rated values, or multiples.

Shock Resistivity

Threshold value indicating that no abnormality occurs even when semisine wave pulsating mechanical shock has been applied to the relay. Even after the shock has been applied, the contacts that have been opened do not close or the contacts that have been closed are not opened.

Vibration Resistivity

In the same manner as shock, threshold value when sine-wave vibration has been repeatedly applied to the relay.

4. Contact Systems and Other Relay Components

According to the different switching functions of the relay contacts, a difference is made between the various contact configurations whose design and description are specified in DIN 41020, ANSI C83.16.

SP, single pole; **DP**, double pole; **ST**, single throw; **NO**, normally open; **NC**, normally closed; **C**, changeover; **B**, break; **M**, make; **DM**, double make; **DB**, double break; **DT**, double throw

Some additional forms:

2C, DPDT; **4C**, 4PDT; **P**, SPST-Latching; **R**, SPDT-Latching.

Armature

The moving magnetic member of an electromagnetic relay structure.

Armature Balanced

A relay armature that rotates about its center of mass and is therefore approximately in balance with both gravitational (static) and accelerative (dynamic) forces.

Armature End-On

A relay armature whose principal motion is parallel to the longitudinal axis of a core having a pole face at one end.

Armature Lever

The distance through which the armature buffer moves divided by the armature travel. Also, the ratio of the distance from the armature bearing pin (or fulcrum) to the armature buffer in relation to the distance from the bearing pin (or fulcrum) to the center of the pole face.

Armature Chatter

The undesired vibration of the armature due to inadequate AC performance or external shock and vibration.

Auxiliary Contact

A contact combination used to operate a visual or audible signal to indicate the position of the main contacts, establish interlocking circuits, or hold a relay operated when the original operating circuit is opened.

Bobbin

A spool or structure upon which a coil is wound.

Bias Electrical

An electrically produced force tending to move the armature towards a given position.

Bias Magnetic

A steady magnetic field (permanent magnet) applied to the magnetic circuit of a relay to aid or impede operations of the armature.

Bias Mechanical

A mechanical force tending to move the armature towards a given position.

Blowout Magnet

A device that establishes a magnetic field in the contact gap to help extinguish the arc by displacing it.

Break Contact (NC Contact)

A contact that is closed in the release (rest) state of a monostable relay and opens (breaks) when the relay coil is energized (operating state).

Bridging Make Contact

Compound contact with two simultaneously operating make contacts connected in series.

Changeover Contact

A combination of two contact circuits including three contact members: a make contact and a break contact with a common terminal. When one of these contact circuits is open, the other is closed and vice versa. On changing the switch position, the contact previously closed opens first followed by the closing of the contact that was previously open.

Coil

An assembly consisting of one or more windings, usually wound over an insulated iron core on a bobbin or spool. May be self-supporting, with terminals and any other required parts such as a sleeve or slugs.

Concentrically Wound — A coil with two or more insulated windings wound one over the other.

Double Wound

A coil consisting of two windings wound on the same core.

Parallel Wound

A coil having multiple windings wound simultaneously, with the turns of each winding being contiguous (see *winding*, *bifilar*).

Sandwich Wound

A coil consisting of three concentric windings in which the first and third windings are connected series aiding to match the impedance of the second winding. The combination is used to maintain transmission balance.

Tandem Wound

A coil having two or more windings, one behind the other, along the longitudinal axis. Also referred to as a two-, three-, or four-section coil, etc.

Clapper

Sometimes used for an armature that is hinged or pivoted.

Cold Switching

Closing the relay contacts before applying voltage and current, plus removing voltage and current before opening the contacts. (Contacts do not make or break current.) Also see [Dry Circuit Switching](#). Larger currents may be carried through the contacts without damage to the contact area since contacts will not “arc” when closed or opened.

Contact Bifurcated

A forked, or branched, contacting member so formed or arranged as to provide some degree of independent dual contacting.

Contact Bounce

An unintentional phenomenon that can occur during the making or breaking of a contact circuit when the contact elements touch successively and separate again before they have reached their final position.

Caused by one or more of the following: impingement of mating contacts; impact of the armature against the coil core on pickup or against the backstop on dropout; momentary hesitation or reversal of the armature motion during the pickup or drop-out stroke.

Contact bounce period depends upon the type of relay and varies from 0.1 to 0.5 ms for small reed relays up to 5 to 10 ms for larger solenoid types. Solid-state or mercury wetted contacts (Hg) do not have a contact bounce characteristic.

Contact Bounce Time

The time from the first to the last closing or opening of a relay contact.

Contact Break-Before-Make

A contact combination in which one contact opens its connection to another contact and then closes its connection to a third contact.

Contact Carrier

Conductive metal part of the relay where the contact is attached to.

Continuous Current

The maximum current that can be carried by the closed contacts of the relay for a sustained time period. This specification is determined by measuring the resistance heating effect on critical relay components.

Contact Erosion

Material loss at the contact surfaces, for example, due to material evaporation by an arc.

Contact Force

The force which two contact tips (points) exert against each other in the closed position under specified conditions.

Contact Gap

The distance between a pair of mating relay contacts when the contacts are open.

Contact Chatter

Externally caused, undesired vibration of mating contacts during which there may or may not be actual physical contact opening. If there is no actual opening but only a change in resistance, it is referred to as dynamic resistance.

Contact Late

A contact combination that is adjusted to function after other contact combinations when the relay operates.

Contact Member

A conductive part of a contact assembly which is electrically isolated from other such parts when the contact circuit is open.

Contact Potential

A voltage produced between contact terminals due to the temperature gradient across the relay contacts, and the reed-to-terminal junctions of dissimilar metals. (The temperature gradient is

typically caused by the power dissipated by the energized coil.) Also known as contact offset voltage, thermal EMF, and thermal offset (in special contact metal combinations a thermal induced voltage of a few 100 μV is possible). This is a major consideration when measuring voltages in the microvolt range. There are special low thermal relay contacts available to address this need. Special contacts are not required if the relay is closed for a short period of time where the coil has no time to vary the temperature of the contact or connecting materials (welds or leads).

Current Rated Contact

The current which the contacts are designed to handle for their rated life.

Current Surge Limiting

The circuitry necessary to protect relay contacts from excessive and possibly damaging current caused by capacitive loads or loads which have a higher current consumption on switch *on* than in subsequent continuous operation (e.g., light lamps).

Contact Rating

The electrical load-handling capability of relay contacts (voltage, current, and power capacities) under specified environmental conditions and for a prescribed number of operations.

Contact Resistance

The resistance of closed contacts is measured as voltage drop across contacts carrying 1 A at 6 VDC for power relays and smaller carrying current for miniature relays. Actually, this is the sum of the contact resistance and conductor resistance.

The maximum initial value (on delivery) is usually set forth on the catalog.

Contact Roll

When a contact is making, the relative rolling movement of the contact tips (points) after they have just touched.

Contact Tip

That part of a contact member at which the contact circuit closes or opens.

Contact Wipe

When a contact is making, the relative nibbling movement of contact tips (points) after they have just touched.

Contact Weld

A contact failure due to fusing of contacting surfaces to the extent that the contacts fail to separate when intended.

Double Pole (Single Throw Version)

A double pole relay switches two electrically not connected common lines with two electrically independent load lines (like two separate make relays).

Double Throw (Single Pole Version)

A double throw (single pole) relay switches one common line between two stationary contacts, for example, between a NO contact and a NC contact (like changeover relay or form C).

Drop-Out Voltage

The voltage at which all contacts return to their “normal,” unoperated positions. (Applicable only to nonlatching relays.)

Dry Switching

Switching below specified levels of voltage and current (usually: <1 mA, <100 mV) to minimize any physical and electrical changes in the contact junction.

Duty Cycle

The ratio between the switch on time and total cycle time during periodical switching. Fifty per cent duty cycle means the switch on time equals the switch off time.

Dynamic Contact Resistance

Variation in contact resistance due to changes in contact pressure during the period in which contacts are motion, before opening or after closing.

Make Contact (NO Contact)

A contact that is open in the release (rest) state of a monostable relay and closes (makes) when the relay coil is energized (operating state).

Maximal Break Current

The highest value of current that can switch an output circuit *off* under specified conditions (voltage, switch off rate, power factor, time constants, etc.).

Maximal Make Current

The highest value of current that can switch an output circuit *on* under specified conditions (voltage, switch on rate, power factor, time constants, etc.). Loads can frequently have a higher current consumption on switch on than in subsequent continuous operation (e.g., light lamps).

Maximal Switching Current

The maximum current that can switch a relay contact *on* and *off*.

Maximum Switching Power

Maximum permissible product of switching current and switching voltage (in W for direct current, in VA for alternating current).

Minimum Switching Capacity

Due to slight corrosion of contacts, a minimum current or voltage is needed to allow fritting to keep the contact resistance low.

Minimum Switching Power

Product of the switching current and switching voltage that should not be undercut to ensure switching.

Movable Contact

The member of a contact combination that is moved directly by the actuating system. This member is also referred to as the armature contact or swinger contact. The moveable contact is mounted on the armature or spring system.

Normally Closed Contact (NC)

A contact combination which is closed when the armature is in its unoperated position.

Normally Open Contact (NO)

A contact combination that is open when the armature is in its unoperated position (generally applies to monostable relays).

Plunger or Solenoid Armature

A relay armature that moves within a tubular core in a direction parallel to its longitudinal axis.

Premake Contact

Twin contact electrically connected where one contact always closes first (premake) and opens last. The premake contact, for example, out of tungsten (high resistive and very resistant to contact erosion), switches the current, while the second, like a low resistive silver contact, carries the load.

Reed Contact

A hermetically enclosed, magnetically operated contact using thin, flexible, magnetic conducting strips as the contacting members which are moved directly by a magnetic force.

Settle Time

The time required for establishing relay connections and stabilizing user circuits. For relay contacts, this includes contact bounce.

Shading Ring

A shorted turn surrounding a portion of the pole of an alternating-current electromagnet that delays the change of the magnetic field in that part, thereby tending to prevent chatter and reduce hum.

Single Contact

Contact configuration with a single stationary and moveable contact pair on the make and/or the break side (compare twin or double contacts).

Single Pole (Single Throw Version)

A single pole (single throw) relay connects one common line (moveable contact) to one load line (stationary contact).

Single Throw (Single Pole Version)

A single throw (single pole) relay connects one common line (moveable contact) to one load line (stationary contact).

Stagger Time

The time interval between the functioning of contacts on the same relay. For example, the time difference between the opening of normally closed contacts on pickup.

Stationary Contact

Nonmoveable contact, mounted on a contact carrier which is directly connected to a relay pin or faston blade.

Switching current

Current that can switch a relay contact *on* and *off*.

5. Specified Terms for Solid-State Relays**Critical Rate of Rise of Off-State Voltage (Critical dv/dt)**

The minimum value of the rate of rise of the forward voltage which will cause switching from the off-state to the on-state.

Critical Rate of Rise of On-State Current (Critical di/dt)

The maximum value of the rate of rise of on-state current which a thyristor can withstand without deleterious effect.

DIP

Dual inline package.

 di/dt

Rate of rise of current.

 dv/dt

Rate of rise of voltage.

FET

Field effect transistor. A device in which the gate voltage (not current) controls the ability of the device to conduct or block current flows.

Gate-Controlled Turn-On Time (t_{gt})

The time interval between a specified point at the beginning of the gate pulse and the instant when the forward voltage (current) has dropped (risen) to a specific, low (high) value during switching of a thyristor from the off-state to the on-state by a gate pulse.

Gate Trigger Current, Input Current, Control Current (I_{GT})

The minimum gate current required to switch a thyristor from the off-state to the on-state.

Gate Trigger Voltage (V_{GT})

The gate voltage required to produce the gate trigger current.

GTO

Gate turn-off thyristor. A thyristor which can be turned on and off by control of its gate current.

Holding current (I_H)

The minimum forward current required to maintain the thyristor in the on-state without control current after its opening.

IGBT

Insulated gate bipolar thyristor. A bipolar power transistor whose gate is voltage-charge controlled in similar manner to the MOSFET.

Latching Current (I_L)

The minimum forward current required to maintain the thyristor in the on-state immediately after switching from the off-state to the on-state has occurred and the triggering signal has been removed.

MOSFET

Metal-oxide-semiconductor field effect transistor. Variety of FET transistor (see [FET](#)).

MOV

Metal oxide varistor. Used for transient suppression.

Off-State dv/dt

The rate of rise of voltage, expressed in volts per microsecond (V/msec), that the SRR output switching device can withstand without turning on.

Off-State Voltage

The maximum effective steady state voltage that the output is capable of withstanding when in off-state without breakover or damage.

On-State Resistance

In a power-FET relay, this is the intrinsic resistance of the output circuit in the on-state.

On-State Voltage or Voltage Drop (V_T , V_{DROP})

The voltage at maximum load current developed across the output switching element (thyristor, triac, etc.) when the relay is in the ON state.

Over-Voltage Rating

The guaranteed transient peak blocking (or breakdown) voltage rating of the SSR.

Peak Gate Power Dissipation

The maximum power which may be dissipated between the gate and main terminal (or cathode) for a specified time duration.

Power Dissipation

The maximum power dissipated by the SSR for a given load current.

Repetitive Overload Current

The maximum allowable repetitive RMS overload current that may be applied to the output for a specific duration and duty cycle while still maintaining output control.

Repetitive Peak Forward Voltage of an SCR (V_{FRM})

The maximum instantaneous cyclic voltage occurs across a thyristor in off-state which it can withstand without turn-on (without control signal).

Repetitive Peak Off-State Current (I_{DRM})

The maximum instantaneous value of the off-state current that results from the application of repetitive peak off-state voltage.

Repetitive Peak Off-State Voltage (V_{DRM})

The maximum instantaneous value of the off-state voltage which occurs across a thyristor, including all repetitive transient voltages, but excluding all nonrepetitive transient voltages.

Repetitive Peak Reverse Current of an SCR (I_{RRM})

The maximum instantaneous value of the reverse current that results from the application of repetitive peak reverse voltage.

Repetitive Peak Reverse Voltage of an SCR (V_{RRM})

The maximum instantaneous value of the reverse voltage which occurs across a thyristor, including all repetitive transient voltages, but excluding all nonrepetitive transient voltages.

SCR

Silicon controlled rectifier. Synonym of word “thyristor.”

SIP

Single inline package.

SMD

Surface mounted device.

Snubber

RC-circuit placed in parallel with a solid-state commutation device to protect against overvoltage transients.

Surge (Nonrepetitive) On-State Current (I_{TSM})

The maximum nonrepetitive surge (or overload) on-state current of short-time duration and specified waveshape that the SCR can safely withstand without causing permanent damage or degradation.

Thermal Resistance, Junction to Ambient

The temperature difference between the thyristor junction and the ambient divided by the power dissipation causing the temperature difference under conditions of thermal equilibrium. Note: Ambient is defined as the point where the temperature does not change as a result of the dissipation.

Triac

Variety of SCR (more complex) especially intended for use in AC circuits.

Voltage Reverse Polarity

The maximum allowable reverse voltage which may be applied to the input of a solid-state relay without permanent damage.

Zero-Voltage Turn On Relay

A relay with isolated input and output in which added control circuitry delays the output turn-on until a zero-voltage transition of the AC sine wave is detected.